

WISCONSIN DEER RESEARCH STUDIES

ANNUAL REPORT 2011–2012



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Wildlife and Forestry Research Section
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WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

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STUDIES

1. Estimating survival and cause-specific mortality of adult male white-tailed deer in Wisconsin (study timeline: 2010–2015)
2. Impact of predation, winter weather, and habitat on white-tailed deer fawn recruitment in Wisconsin (study timeline: 2011–2013)

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CONTRIBUTORS



HIGHLIGHTS

Note: If deer survived to May following winter capture we considered yearlings as adults and fawns as yearlings.

Buck mortality study

- 16 males (≥ 1.6 years old) and 25 male fawns (8–10 months old) were radiocollared and ear tagged in the northern study area.
- 15 males (≥ 1.6 years old) and 40 male fawns (8–10 months old) were radiocollared and ear tagged in the eastcentral study area.
- Adult male survival (10–12 months post capture) was 31% and 27% in the northern and eastcentral study areas, respectively; hunter harvest was the greatest (73–91%) source of mortality in both areas.
- Yearling male survival (10–12 months post winter capture) was 52% and 58% in the northern and eastcentral study areas, respectively; hunter harvest was the greatest (82–92%) source of mortality in both areas.
- 35% and 55% of male deer (10–18 months old) dispersed in the northern (1–22 miles) and eastcentral (2–20 miles) study areas, respectively.
- Spring yearling male dispersal rates and distances were similar between study areas; however, fall dispersal in northern Wisconsin occurred at $\leq 50\%$ the rate of fall dispersal in eastcentral Wisconsin.
- 11–15% of adult female deer in the northern study area migrated seasonally, but no seasonal migration was detected in the eastcentral study area.

Fawn recruitment study

- Most fawn births occurred during late May in both study areas.
- 30 (16 males and 14 females) and 46 (26 males and 20 females) neonate fawns were radiocollared and ear tagged in the northern and eastcentral study areas, respectively.
- Fawn survival (6–7 months of age) was 47% and 63% in the northern and eastcentral study areas, respectively.
- Most fawn mortalities occurred during mid-May and June, and predation was the leading (55%) cause of mortality (6–7 month of age) for both study areas, followed by road kill (mainly the eastcentral area).
- Weekly survival for fawns (2011 and 2012 captures) up to 16 weeks of age was less in the northern study area compared to the eastcentral study area, but was similar between years and between males and females.
- 30 and 7 adult does were radiocollared in the northern and eastcentral study areas, respectively.
- Adult female survival (10–12 months post capture) was 73% and 86% in the northern and eastcentral study areas, respectively.
- Predation was the leading (44%) cause of adult female mortality, followed by hunter harvest (33%).



Public outreach

- 316 volunteers helped with 2012 fawn capture over a 16 day period during May and June.
- Over 1000 volunteers have helped with the project as of June 2012.
- 35 presentations, 10 television programs/interviews, 7 radio shows, and over 50 articles (e.g. newspaper and web pages) have been written about the studies.
- Our project website <http://dnr.wi.gov/topic/wildlifehabitat/research/whitetaileddeer.html> was updated with new information, including photos and maps of buck movements.

BACKGROUND

White-tailed deer (*Odocoileus virginianus*) are the most widespread and abundant cervid in North America, occurring throughout the contiguous United States except Utah^[1, 2]. In Wisconsin, deer are a favored wildlife species among hunters and non-hunters and are considered a major factor in the state's recreational economy^[3]. Wisconsin's deer herd is managed by adjusting harvest quotas relative to overwinter population goals in established deer management units across the state. Broadly speaking, effective deer management strategies strive to balance ecological, social, cultural, and economic factors to maximize positive (while minimizing negative) impacts of deer on people and the environment. Understanding survival and cause-specific mortality factors is essential for accomplishing deer management objectives, particularly as it relates to population demographics and dynamics^[4]. Thus, a greater understanding of mortality factors throughout Wisconsin's deer management regions will provide wildlife managers and decision makers with information critical for improving the state's current deer management program.

The Wisconsin Department of Natural Resources (WDNR) has relied on a mathematical formula known as the Sex-Age-Kill (SAK) model to estimate white-tailed deer populations in deer management units across the state since the early 1960s. These estimates form the basis for management (hunting quotas) and have been a source of ongoing controversy with stakeholders (particularly hunters) for the past 50 years. A primary weakness of the model is that rigorous scientific estimates of mortality in adult male deer, a key variable in the SAK model, currently do not exist. The SAK model is a procedure that estimates the pre-hunt population prior to the start of the annual hunting season, therefore population estimates are based on the number of deer available for harvest at the beginning of the hunting season. This method allows pre-season predation to be accounted for in pre-hunt deer population estimates. An important assumption of the SAK method is that the aged sample of harvested bucks represents the population age structure. This assumption could be

violated if hunters actively select against harvesting bucks with smaller antlers (primarily yearling bucks) or if vulnerability to harvest is higher in yearling than adult male deer. The age structure of harvested bucks in much of the state, particularly in the farmland regions, has changed markedly since the 1990s with the percentage of yearlings in the harvest declining from 80–85% in the 1980s to 50–60% in the mid-2000s. Increasing interest among hunters in harvesting large antlered bucks during the past 10–15 years has raised concerns about possible hunter selection bias against yearlings. There is uncertainty about how much changes in harvest age structure reflects changes in hunter selection and how much is due to changes in mortality rates.



To improve SAK population estimates, an independent review of the SAK model by an external review panel recommended that the WDNR implement a long-term radiotelemetry study to obtain direct estimates of the buck (male deer) harvest rate or its components (buck survival and cause-specific mortality rates) over multiple years and across varying habitat types^[5]. However, this recommendation is confounded by the fact that radiotelemetry (the standard technique for estimating mortality rates) is likely biased with respect to hunting mortality (greatest mortality factor with respect to the SAK model) because hunters likely see and react to the presence of radiocollars in complex and unknown ways. Therefore, while estimating cause-specific mortality

of male deer is a priority for deer management in Wisconsin, doing so with scientific rigor will require methods that are relatively resistant to biases associated with radiocollars, despite continued use of radiocollars for identifying non-hunting sources of mortality.

Recruitment, or when an animal becomes a reproducing member of a population, is a primary influence in deer population growth^[6]. Recruitment is often influenced by many factors (e.g., winter severity or habitat), but predation is commonly a major influence in decreased recruitment rates^[7]. Fluctuating populations of large predators including black bears (*Ursus americanus*), wolves (*Canis lupus*), bobcats (*Lynx rufus*), and coyotes (*Canis latrans*) in Wisconsin, have increased concerns of stakeholders and wildlife managers that fawn predation may be limiting recruitment in Wisconsin's deer population. Predation of white-tailed deer fawns has been studied extensively throughout North America, yet no information currently exists on the potential effects of predation on recruitment of deer specifically in Wisconsin.



Fecundity, or essentially birth rates, is another primary influence in deer population growth^[8]. Although fecundity rates estimated in the 1980's were satisfactory (1.64–1.93 fawns/doe; ^[9]), limited information exists to explain declining fawn:doe ratios in recent years, particularly across the northern forest region. Declining ratios could be a result of many factors, including increased predation rates, winter severity, habitat conditions (e.g. prolonged drought conditions reducing cover), poor nutritional condition of adult females, or decreased pregnancy rates. These factors are typically interdependent and can collectively influence fawns mortality rates, often within the

first few months of life. Although predation may often be a primary factor limiting fawn recruitment, predation rates may be influenced by the interaction of other factors (e.g., harsh winter or ground cover density) that predispose deer to predation^[10]. Evaluating the interactions and relative role of factors that influence deer recruitment and fecundity rates can assist in providing essential information on what factor(s) are influencing deer population growth. Additionally, research evaluating the magnitude of cause-specific mortality and survival of white-tailed deer fawns in relation to winter severity and habitat would provide much needed information to wildlife managers for decisions of deer management strategies across Wisconsin.



Wildlife disease can also influence deer population growth and herd health. Wildlife disease transmission is generally thought to be density dependent, whereby contact among individuals will be greater in dense populations. However, the effect high deer densities have on transmission in Wisconsin deer herds is relatively unknown.

A primary goal of our research is to estimate survival and cause-specific mortality rates of adult male and fawn white-tailed deer in the northern forest and eastcentral farmland deer management regions of Wisconsin. Also, we are quantifying the influence of predation, winter severity, and potential habitat effects on fawn survival and subsequent recruitment in these same deer management regions. Additionally, our research provides a unique opportunity to gather disease surveillance data, particularly related to deer density.

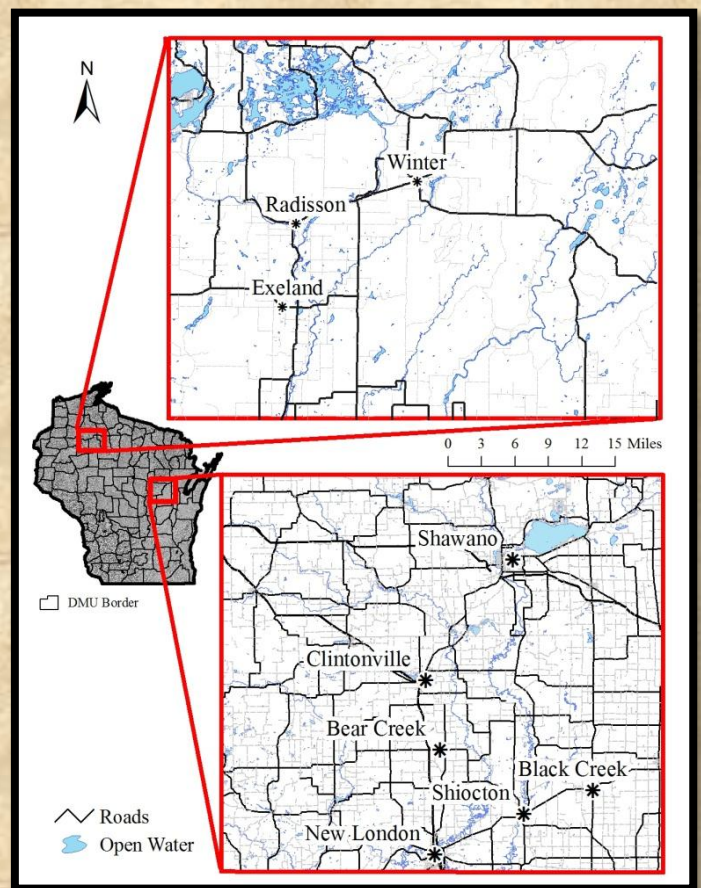
OBJECTIVES

1. Estimate monthly, seasonal, and annual survival and cause-specific mortality rates of fawn and adult female white-tailed deer.
2. Evaluate factors contributing to and/or provide updated information on white-tailed deer pregnancy and fawn recruitment rates in northern and eastcentral Wisconsin.
3. Evaluate movements, home range, and habitat selection of fawns and bucks.
4. Estimate hunter deer harvest bias by comparing survival rates among radiotelemetry, mark-recapture, and age structure analyses.
5. Evaluate cost comparisons for age structure, telemetry, and mark-recapture techniques and feasibility of these techniques for routine population monitoring.
6. Evaluate the effectiveness and suitability of mark-recapture (*i.e.*, tagging) techniques for monitoring annual variation in buck harvest rates relative to time-dependent and time-independent factors.
7. Evaluate radiotelemetry as a technique for obtaining short-term direct estimates of buck harvest rates.

STUDY AREAS

Research is occurring in two study areas within the northern and eastcentral regions of Wisconsin. These areas were selected because of dissimilar habitat compositions and variability in buck harvest rates. The northern study area (3,557 mi²), including portions of Sawyer, Price, and Rusk counties, is about 34% public owned land and about 80% forested with moderately rolling hills^[11]. Comparatively, the eastcentral study area (2,318 mi²), including portions of Shawano, Waupaca, and Outagamie counties, is about 3% public owned land and about 35% forested with gently rolling hills of small woodlands interspersed throughout predominant row crop and pasture land. Road density is about 1.6 mi/mi² in the northern study area, compared to 2.6 mi/mi² in the eastcentral study area.

The northern area annually averages about 58 inches of snow, whereas the eastcentral area receives about 46 inches^[12]. Annual temperatures are similar between areas, ranging between about 13–67°F. Post-hunt deer densities in the northern area are between 15–31 deer/mi² of deer range (*i.e.*, land available to deer), but increase to 44–80 deer/mi² of deer range in the eastcentral area (Wisconsin DNR, unpublished data). Hunting pressure on opening day of the 9-day gun deer season ranges between 8–15 hunters/mi² of deer range in the northern area, but ranges between 21–36 hunters/mi² of deer range in the eastcentral area (Wisconsin DNR, unpublished data). Black bear, gray wolf, coyote, and bobcat are typical predators in the northern area, whereas bobcat and coyote are typical predators in the eastcentral area.



CAPTURE AND SAMPLING METHODS

BUCK MORTALITY STUDY

Capture

Project staff used several methods to capture deer from December through March, including netted-cage (Clover) traps, box traps, and drop nets (see SUPPLEMENTS). Once captured, adult and yearling (≥ 1.6 years old) and fawn (7–10 months old) males were restrained and blindfolded to reduce handling stress. If necessary, antlered or aggressive males were chemically immobilized and monitored for temperature, pulse, and respiration rates. All deer were given uniquely-numbered metal ear tags and select males were fitted with expandable mortality-sensing radiocollars, which allow for neck growth with age or during the breeding (“rut”) season. Before release chemically immobilized deer were administered a chemical which “reverses” the effects of the immobilization drugs. If deer survived to May following winter capture we considered yearlings as adults and fawns as yearlings.

Sampling

When available several male deer anatomical measurements (*e.g.*, chest girth), body weight, body condition, and age class were estimated. Blood and ectoparasite (*e.g.*, lice and ticks) samples were opportunistically collected from select males. Blood serum was sent to the Minnesota Veterinary Diagnostic Laboratory to assess presence of several potential diseases; and ectoparasites were provided to University of Wisconsin-Stevens Point for analyses.

Survival and movements

Movement and survival status of radiocollared males was monitored 1–2 times weekly using aerial or ground telemetry. We analyzed location data from male deer (10–18 months old) to assess permanent dispersal, defined as permanent emigration when postdispersal locations did not overlap predispersal locations^[13]. Mortalities were assigned into categories, such as harvest, road kill, and predation. Identification of predator-specific mortalities was assessed using signs at kills (*e.g.*, tracks, hair, and tooth spacing) and the manner of predation, such as cached (likely bobcat; see SUPPLEMENTS) or long bones consumed (likely wolf). Researchers conducted field necropsies when available to search for presence of tissue hemorrhaging that indicates deer were alive when killed, thereby differentiating predation from potential scavenging events. When mortality cause was not evident, deer were sent to the WDNR Wildlife Health Laboratory for complete necropsy. Male movements were estimated using radiotelemetry locations to assess seasonal dispersal, migration, and general movement patterns. Males are being monitored until death or until loss of contact with radiocollars.



Buck with expandable radiocollar



Chemically immobilized buck with blindfold

FAWN SURVIVAL STUDY

Capture

Adult females—females were captured concurrently during the buck mortality study winter capture. Females were chemically immobilized, blindfolded to reduce handling stress, and monitored for temperature, pulse, and respiration rates. Females deemed pregnant using a portable ultrasound were fitted with mortality-sensing radiocollars and vaginal implant transmitters that expel upon fawn birth and assist crews in locating and capturing neonate fawns. Before release chemically immobilized deer were administered a chemical which “reverses” the effects of the immobilization drugs.



Vaginal implant transmitter

Neonate fawns—during May and June, fawns were captured opportunistically and during systematic searches around areas of probable fawning habitat (*e.g.*, grasslands and swamps) or where vaginal implant transmitters were expelled. Fawns were blindfolded to reduce handling stress, fitted with expandable mortality-sensing radiocollars, and ear tagged with individually identifiable metal ear tags. Fawn radiocollars are designed to drop off after about one year.

Sampling

Adult females—researchers recorded several anatomical measurements (*e.g.*, body length) and estimated body weight and body condition. Blood, ectoparasite, and incisor tooth samples for exact aging were also collected from select adult females; teeth were not collected from yearling females.

Neonate fawns—researchers recorded body weight, new hoof growth, sex, and estimated age at capture. Also, researchers recorded fawn handling time, fawn and dam behavior at capture, and presence of dam and/or additional deer during handling.



Attaching ear tags to radiocollared neonate fawn



Crew searching for neonate fawns

Environmental variables—researchers estimated vegetation structure, composition, and density at and around fawn capture and bed sites, and the distance of capture and bed sites to water and nearest habitat edge. These estimates were also collected at random sites across the study areas to assess if fawn survival is related to birth site selection of does and habitat variables which could influence deer nutritional condition and predation risk. Daily temperature and precipitation data for the period from the first fawn collared of the year through the end of August was obtained from the closest NOAA^[14] weather stations to the study areas (Green Bay and Hayward).

Survival and movements

Movement and survival status of radiocollared adult females was monitored 1–2 times weekly using aerial or ground telemetry. Radiocollared fawns were monitored daily through August using aerial or ground telemetry and are currently being monitored weekly for survival and movement. Adult female and fawn mortality assessment and categorization followed the same protocol used in the buck mortality study. However, beginning in 2012 we submitted intact fawn carcasses to the University of Wisconsin–Madison, Department of Pathobiological Sciences for necropsy. Fawn survival was estimated using staggered-entry Kaplan-Meier estimation^[15] and covariates (*e.g.*, precipitation) of survival were assessed using Bayesian regression^[16] with a cumulative log-log link function. We assessed if survival differed between sexes, study areas, or years from birth to 16 weeks of age because most mortalities of fawns captured in 2011 and 2012 occurred before this date. Adult female movements were estimated using radiotelemetry locations to assess seasonal dispersal, migration, and general movement patterns. Adult females and fawns are being monitored until death, radiocollars drop off (fawns), or until loss of contact with radiocollars.

RESULTS

BUCK MORTALITY STUDY

Northern Forest

We captured 111 unique deer from December 18th 2011 to March 19th 2012, including 42 males and 69 females (Figures 1, 2). We radiocollared 41 males, including 16 adults or yearlings (8 were ≥ 2.5 years old) and 25 fawns (8–10 months old). We fitted 30 adult or yearling females (27 were ≥ 2.5 years old) with radiocollars and vaginal implant transmitters. Twenty-nine deer were recaptured, including 17 males and 12 females. Thirty-nine deer were captured with drop nets, followed by 38 with box traps, and 34 with netted cage traps. We captured 66 deer on public land, 36 on private land, and 9 on Managed Forest Land.



Figure 1. Fawn (8–10 months old) and adult deer captures by sex in northern Wisconsin, mid-December 2011 through March 2012.

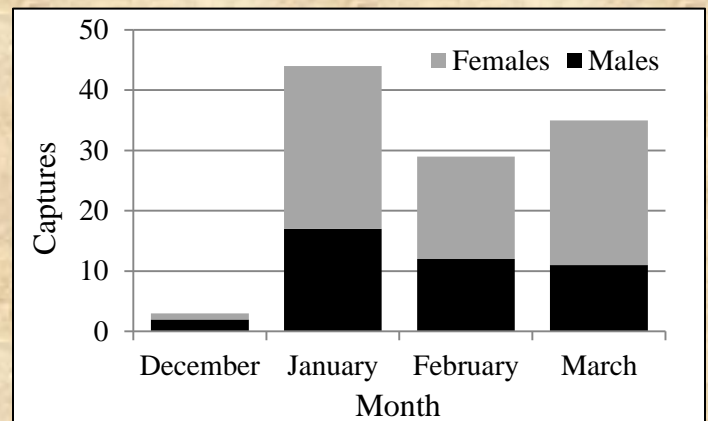


Figure 2. Male or female deer captures in northern Wisconsin, mid-December 2011 through March 2012.

Adult and yearling males were slightly larger than adult and yearling females and male fawns (8–10 months old) were generally larger than female fawns (Table 1). We obtained a blood sample from 52 deer, including 13 males and 39 females. We found ectoparasites (*e.g.*, lice) on 49 deer, including 12 males and 37 females.

Table 1. Mean and standard error of adult and fawn (8–10 months old) male and female white-tailed deer body weight and anatomical measurements in northern Wisconsin, mid-December 2011 through March 2012. Distal neck measured ventral to the chin and proximal at the base of neck anterior to the front shoulders.

Estimate	Adult males (<i>n</i> = 16)	Male fawns (<i>n</i> = 26)	Adult females (<i>n</i> = 43)	Female fawns (<i>n</i> = 26)
Body weight (lbs.)	162.7 ± 6.3	85.6 ± 5.7	159.5 ± 5.7	77.8 ± 3.7
Chest girth (inches)	36.4 ± 1.2	31.4 ± 0.6	36.8 ± 0.4	30.6 ± 0.7
Hind foot (inches)	13.9 ± 0.3	12.6 ± 0.3	13.6 ± 0.4	12.4 ± 0.2
Distal neck (inches)	13.7 ± 0.5	12.4 ± 0.3	14.0 ± 0.2	11.8 ± 0.2
Proximal neck (inches)	16.5 ± 0.7	15.6 ± 0.4	18.7 ± 0.3	14.6 ± 0.6

Mortality

Survival (10–12 months post capture) for all radiocollared males was 44%. Eleven of 16 adult and 12 of 25 yearling (*i.e.*, fawns during winter capture) male mortalities occurred as of December 31st 2012, representing 31% and 52% survival for these cohorts, respectively. Survival estimates assume “censored” males (*i.e.*, those which we lost contact or dropped their collars; *n* = 9) were alive until the end of the monitoring period. Hunter harvest (*n* = 8; [5 archery, 3 firearm]) was the greatest source of adult male mortality, followed by wolf (*n* = 2) and coyote (*n* = 1) predation. Hunter harvest (*n* = 11; [9 firearm, 2 archery]) was the greatest source of yearling male mortality, with an additional unknown predation. Three adult and 10 yearling males are being monitored as of December 31st 2012.

Telemetry

We estimated 2,564 male locations as of October 31st 2012, including a median of 26 locations/adult male (range = 1–61; *n* = 41) and a median of 28 (range = 3–64; *n* = 70) locations/male yearling.

Movements

Thirty-five percent of male (10–18 months old) deer permanently dispersed (Figure 3; also see SUPPLEMENTS), with two major dispersal periods during ages 10–13 months old and 15–18 months old. Although apparent dispersal may have been confounded with seasonal migration which occurs in northern Wisconsin, we found the migration rate from 53 radiocollared adult female deer to be minimal (11–15%) in northern Wisconsin. Additionally, the timing of migration from winter to summer home ranges and vice versa typically occurred during different periods of the year (March and December-January).

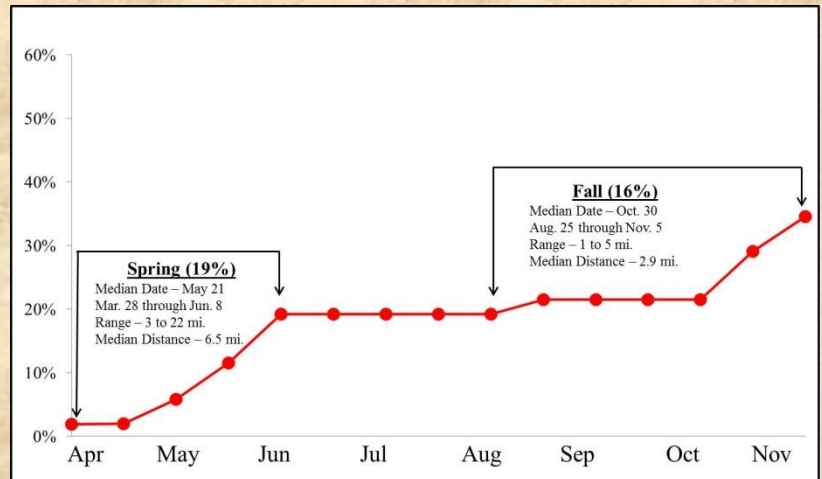


Figure 3. Timing and rate of permanent dispersal for male deer (10–18 months old) in northern Wisconsin, late-March 2011 through November 2012 (*n* = 53). Vertical axis is dispersal rate.

Eastcentral farmland

We captured 107 unique deer from December 12th 2011 through March 29th 2012, including 59 males and 48 females (Figures 4, 5). We radiocollared 55 males, including 15 adults or yearlings (4 were ≥ 2.5 years old) and 40 fawns (≥ 8 months old). We fitted 7 adult or yearling females (5 were ≥ 2.5 years old) with radiocollars and vaginal implant transmitters. Nineteen deer were recaptured, including 6 males and 13 females. Sixty-two deer were captured with drop nets followed by 34 with netted cage traps and 11 with box traps. We captured 4 deer on public land, compared to 103 on private land.

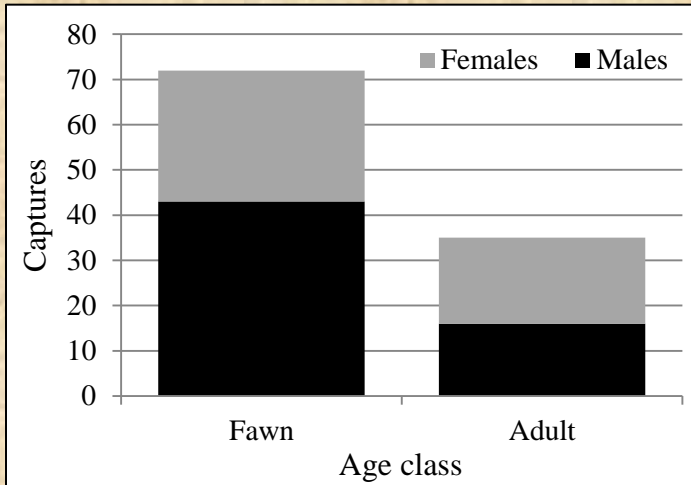


Figure 4. Fawn (8–10 months old) and adult deer captures by sex in eastcentral Wisconsin, mid-December 2011 through March 2012.

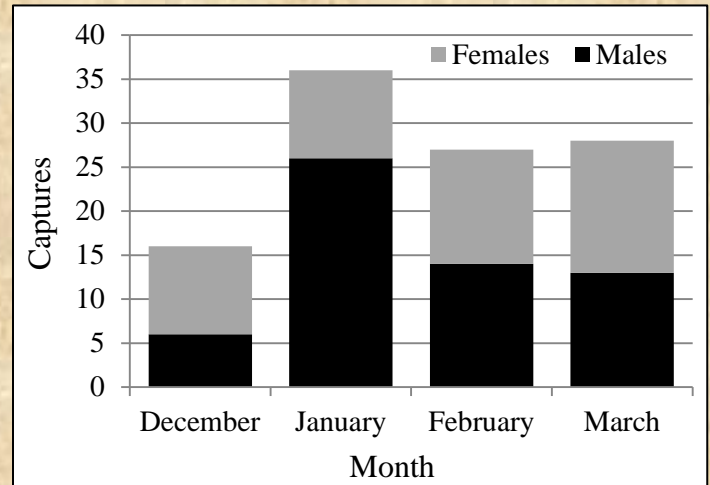


Figure 5. Male or female deer captures in eastcentral Wisconsin, mid-December 2011 through March 2012.

Adult and yearling males were generally larger than adult and yearling females, but male and female fawns (8–10 months old) were comparable in size (Table 2). We obtained a blood sample from 59 deer, including 31 males and 28 females. We found ectoparasites (*e.g.*, lice) on 55, including 27 males and 28 females.

Table 2. Mean and standard error of adult and fawn (8–10 months old) male and female white-tailed deer body weight and anatomical measurements in eastcentral Wisconsin, December 2011 through March 2012. Distal neck was measured under the chin and proximal at the base of neck in front of the shoulders.

Estimate	Adult males (<i>n</i> = 16)	Male fawns (<i>n</i> = 43)	Adult females (<i>n</i> = 19)	Female fawns (<i>n</i> = 29)
Body weight (lbs.)	157.7 ± 7.3	71.1 ± 7.5	135.6 ± 10.1	69.6 ± 1.9
Chest girth (inches)	37.5 ± 0.4	31.1 ± 0.4	37.0 ± 0.7	30.5 ± 0.4
Hind foot (inches)	13.1 ± 0.3	11.4 ± 0.3	13.2 ± 0.2	11.4 ± 0.2
Distal neck (inches)	16.0 ± 0.5	12.3 ± 0.2	13.7 ± 0.3	11.6 ± 0.2
Proximal neck (inches)	20.9 ± 0.7	14.9 ± 0.3	16.7 ± 0.4	14.0 ± 0.3

Mortality

Survival (10–12 months after capture) for all radiocollared males was 49%. Eleven of 15 adult and 17 of 40 yearling (*i.e.*, fawns during winter capture) male mortalities occurred as of December 31st 2012, representing 27% and 58% annual survival for these cohorts, respectively. Survival estimates assume “censored” males (*i.e.*, those which we lost contact or dropped their collars; $n = 11$) were alive until the end of the monitoring period. Hunter harvest ($n = 10$; [8 firearm, 1 archery, 1 wounding]) was the greatest source of adult male mortality, with an additional road kill. Hunter harvest ($n = 14$; [4 archery, 7 firearm, 2 wounding, 1 poaching]) was the greatest source of male yearling mortality, followed by road kill ($n = 2$) and coyote ($n = 1$) predation. Two male fawn (8–10 months old) capture related mortalities occurred prior to or during handling; however capture related mortality for all deer decreased to 2% from 6% the previous year, predominantly due to trap modifications. Four adult males and 15 male yearlings are being monitored as of December 31st 2012.



Harvested adult male (radiocollar removed)

Telemetry

We estimated 3,134 male locations as of October 31st 2012, including a median of 30 locations/adult male (range = 7–63; $n = 33$) and a median of 28 (range = 1–71; $n = 68$) locations/male yearling.

Movements

Fifty-five percent of males (10–18 months old) permanently dispersed, (Figure 6; also see SUPPLEMENTS), with two major dispersal periods during ages 10–13 months old and 16–18 months old. We found very little evidence for seasonal migration in eastcentral Wisconsin.

FAWN SURVIVAL STUDY

Northern Forest

We captured 32 neonate fawns between May 14th and June 5th 2012, including 17 males and 15 females. Thirty fawns were radiocollared, including 16 males and 14 females, remaining fawns were ear tagged. Five fawns were captured with searches around expelled vaginal implant transmitters, resulting in 17% effectiveness of finding at least one fawn from all implanted does ($n = 30$). Remaining fawns were captured opportunistically, including several public reports of fawn sightings. Twenty-four fawns were captured on private land, 6 on public land, and 2 on Managed Forest Land. Fawn births did not exhibit a sharp pulse, but were greatest during the last week of May (Figure 7). Mean body weight for all fawns was 10.9 ± 3.5 lbs. and was 10.6 ± 4.5 for males and 11.1 ± 2.6 for females. Mean new hoof growth for all fawns was 1.0 ± 0.6 mm and was 0.9 ± 0.7 for males and 1.1 ± 0.5 for females. Mean estimated age at capture was 3.4 ± 1.7 days.

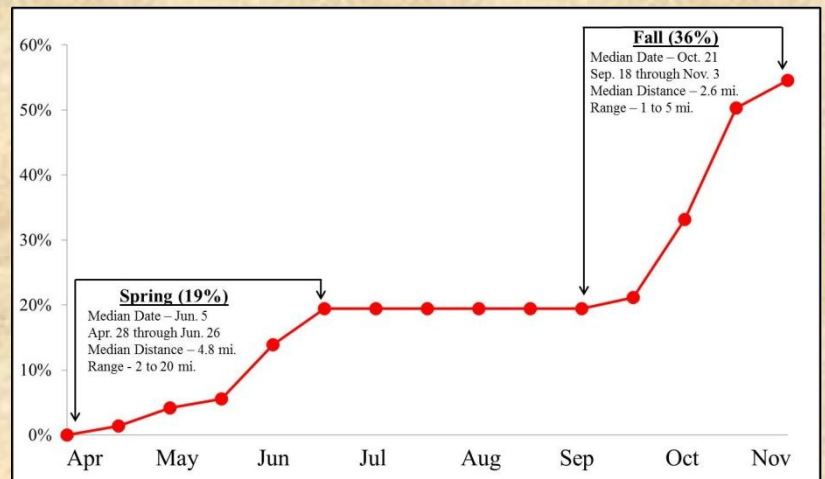


Figure 6. Timing and rate of permanent dispersal for male deer (10–18 months old) in eastcentral Wisconsin, late-March 2011 through November 2012 ($n = 72$). Vertical axis is dispersal rate.

Mortality

Eight mortalities of 30 radiocollared adult females occurred, representing 73% survival (10–12 months post capture) for this cohort. Predation ($n = 4$; [2 unknown predator, 1 coyote, 1 wolf]) was the greatest source of adult female mortality, followed by hunter harvest ($n = 2$; all firearm), road kill ($n = 1$), and unknown ($n = 1$). Thirty-three adult females are being monitored as of December 31st 2012.

Sixteen mortalities of 30 radiocollared fawns occurred, representing 47% survival (6–7 months post capture) for this cohort. This survival estimate assumes “censored” fawns (i.e., those which we lost contact or dropped their collars; $n = 1$) were alive until the end of the monitoring period. Most mortalities occurred before the August 31st (Figure 8) and predation was the greatest source of mortality (Table 3). Ten male and 6 female fawn mortalities occurred as of December 31st 2012, representing 38% and 57% survival (6–7 months of age) for these cohorts, respectively. Fourteen radiocollared fawns (6 males and 8 females) are being monitored as of December 31st 2012.

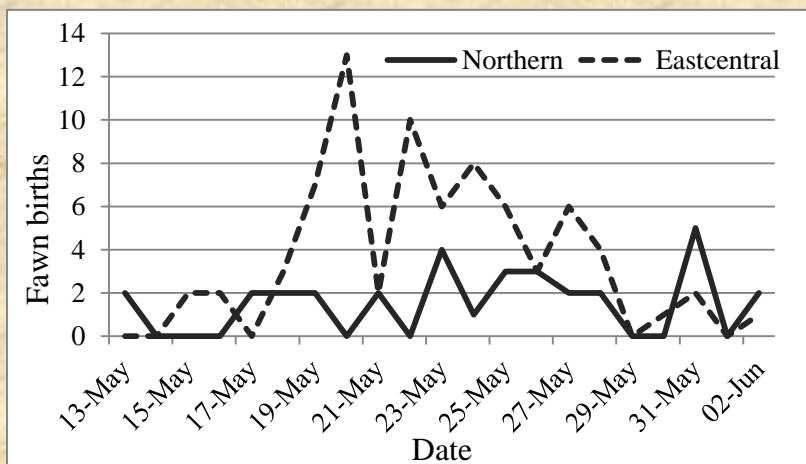


Figure 7. Neonate fawn births ($N = 108$) estimated from fawn capture date and new hoof growth in northern and eastcentral Wisconsin, mid-May–June 2012.

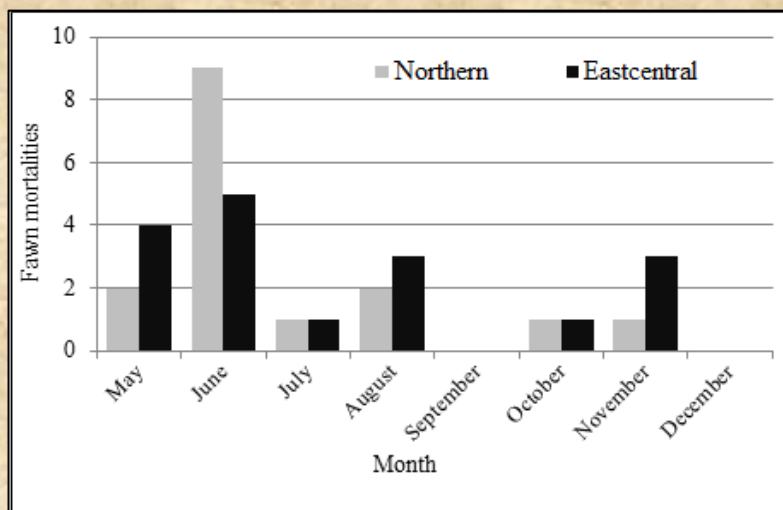


Figure 8. Predations of radiocollared fawns captured as neonates mid-May–June 2012 in northern ($n = 30$) and eastcentral ($n = 46$) Wisconsin.



Telemetry

We estimated 2,066 adult female locations as of October 31st 2012, including a median of 29 locations/adult female (range = 1–60; $n = 69$). We estimated 430 fawn locations as of December 1st 2012, including a median of 11 locations/male fawn (range = 3–36; $n = 15$) and 10 locations/female fawn (range = 1–43; $n = 15$).

Vegetation surveys

We completed 130 surveys of vegetation composition and structure, including 65 at fawns birth or bed sites and 65 at random sites. Researchers are currently analyzing these data.

Eastcentral farmland

We captured 76 neonates between May 16th and June 5th 2012, including 43 males and 33 females. Forty-six fawns were radiocollared, including 26 males and 20 females, remaining fawns were ear tagged. Six fawns were captured with searches around expelled vaginal implant transmitters, resulting in 87% effectiveness of finding at least one fawn from all implanted does ($n = 7$). Remaining fawns were captured opportunistically, including several public reports of fawn sightings.

Sixty-eight fawns were captured on private land and 8 on public land. Fawn births appeared to peak around the third week of May (Figure 7). Mean body weight for all fawns was 11.2 ± 2.8 lbs. and was 11.3 ± 2.8 for males and 11.5 ± 3.2 for females. Mean new hoof growth for all fawns was 1.5 ± 0.6 mm and was 1.5 ± 0.1 for males and 1.6 ± 0.1 for females. Mean age at capture was 3.2 ± 1.5 days.

Mortality

One mortality of seven radiocollared adult females occurred, representing 86% survival (10–12 months post capture) for this cohort. Hunter harvest (muzzleloader) was the only source of adult female mortality. One adult female capture-related mortality occurred prior to handling; however capture related mortality for all deer decreased to 2% from 6% the previous year, predominantly due to trap modifications. Fourteen adult females are being monitored as of December 31st 2012.

Seventeen mortalities of 46 radiocollared fawns occurred, representing 63% survival (6–7 months post capture) for this cohort. This survival estimate assumes “censored” fawns (*i.e.*, those which we lost contact or dropped their collars; $n = 6$) were alive until the end of the monitoring period. Most mortalities occurred before the August 31st (Figure 8) during which time predation was greatest source of mortality (Table 3). Ten male and 7 female fawn mortalities occurred as of December 31st 2012, representing 62% and 65% (6–7 months of age) survival for these cohorts, respectively. Twenty-four radiocollared fawns (14 males and 10 females) are being monitored as of December 31st 2012.

Table 3. Mortality sources of radiocollared fawns captured as neonates mid-May–June 2012 in northern ($n = 30$) and eastcentral ($n = 46$) Wisconsin.

Mortality source	Northern		Eastcentral	
	Males	Females	Males	Females
Unknown predator	3	3	1	1
Coyote	1	1	2	3
Road kill	1	-	2	2
Unknown	1	2	1	-
Starvation	1	-	2	1
Black bear	2	-	1	-
Harvest	1	-	1	-

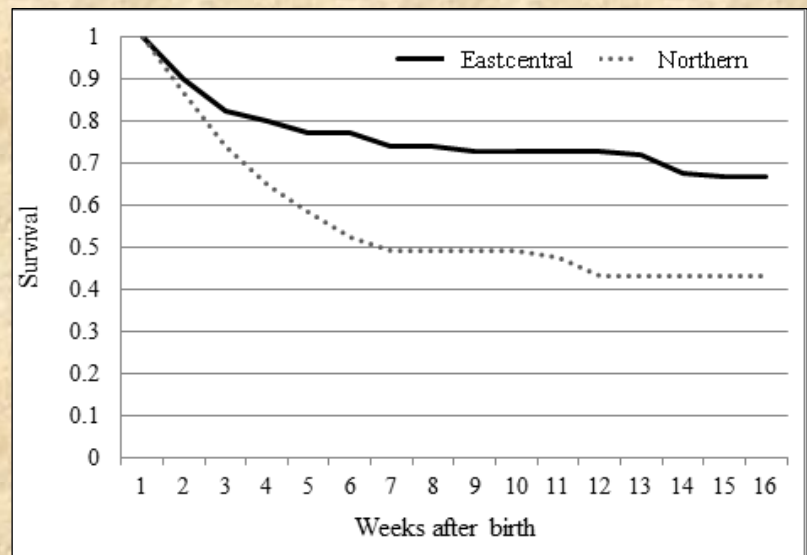


Figure 9. Weekly survival^[15] estimates of fawns captured (mid-May 2011 through June 2012) as neonates from birth to 16 weeks of age in northern ($n = 60$) and eastcentral ($n = 94$) Wisconsin.

Telemetry

We estimated 1,160 adult female locations as of October 31st 2012, including a median of 46 locations/adult female (range = 6–61; $n = 45$). We have estimated 1,161 fawn locations as of December 1st 2012, including a median of 13 locations/male fawn (range = 1–40; $n = 38$) and a median of 11 locations/female fawn (range = 1–43; $n = 36$).

Vegetation surveys

We completed 250 surveys of vegetation composition and structure, including 125 at fawns birth or bed sites and 125 at random sites. Researchers are currently analyzing these data.

Fawn survival comparisons

Weekly survival to 16 weeks of age for fawns captured in 2011 and 2012 was greater (Table 4) in the eastcentral study area compared to the northern study area (Figure 9). However, weekly fawn survival to 16 weeks of age did not differ between male and female fawns or between fawns captured in 2011 and 2012 (Table 4). Additionally, weekly survival of fawns captured 2011–2012 in both study areas ($n = 154$) increased with increasing mean daily temperature and decreasing mean daily precipitation.

PUBLIC OUTREACH

From January 2011–June of 2012 over 1000 volunteers helped with the buck mortality study, including volunteers from Wisconsin, but also from Minnesota, Illinois, Michigan, and Indiana. Similarly, from May 20th through June 5th 2012 we had 316 volunteers help with the fawn recruitment study. Further, over 800 landowners have participated, many of which have granted us property access to capture and monitor study animals. Since its launch in April 2010, our website has been continually updated and assisted in communicating our research design and preliminary results and volunteer opportunities for the public. The web address is: <http://dnr.wi.gov/topic/wildlifehabitat/research/whitetaileddeer.html>.

Additions to the website include photos of our capture techniques, deer movement maps, trail camera photos of radiocollared deer, and volunteer sign up form. We also distributed 23 maps with capture, telemetry, and harvest location data to hunters that harvested ear tagged or radiocollared deer during the 2011–2012 deer season. We developed a tri-fold project pamphlet and newsletter for public distribution across the northern and eastcentral study areas. We have done 35 presentations, 10 television programs/interviews, 7 radio shows, and more than 50 articles (e.g. newspaper and web pages) have been written about the project.

Table 4. Comparisons of survival^[15] estimates of fawns captured (mid-May 2011 through June 2012) as neonates from birth to 16 weeks of age in northern and eastcentral Wisconsin.

Population <i>a</i>	Population <i>b</i>	χ^2	<i>P</i> -value
Northern ($n = 60$)	Eastcentral ($n = 94$)	9.54	$P < 0.002$
Males ($n = 85$)	Females ($n = 69$)	2.36	$0.2 > P > 0.1$
2011 ($n = 78$)	2012 ($n = 76$)	0.12	$P > 0.2$



UPCOMING RESEARCH ACTIVITIES

Winter capture

During December 2012 field crew members contacted numerous private landowners throughout the northern and eastcentral study areas who allowed trapping on their properties and also many which had not been contacted previously. Subsequently bait sites were established on properties which allowed trapping and had promising deer sign. Crews placed net and box traps and drop nets at bait site locations during late December and early January to get deer accustomed to these devices. Lead researchers conducted a preliminary trapping activity prior to allowing crews to capture deer independently to promote crew members familiarity and efficiency with trapping, handling, safety, and data collection procedures. Deer trapping began on December 26th 2012 in the northern study area, primarily on public lands, and January 7th 2013 in the eastcentral study area. Trapping primarily in the eastcentral area was delayed until after all harvest seasons were finished on the majority of private land.

Prior to capture, crews also verified traps had modifications made last year which decreased capture-related deer injury and mortality. Additionally, we modified the expandable buck radiocollar design to ensure proper neck fit, which will likely reduce the likelihood of entanglement of legs or other unanticipated complications related to improper collar fit. Additionally, we will increase the duration and number of drop nets used for deer capture during 2013 to increase selectivity potential for targeting adult male deer, particularly in the eastcentral study area.

Fawn capture

The fawn recruitment study has been approved and funded for 2013 and crews will begin opportunistically searching for fawns beginning in mid-May. Fawns will be captured in the northern and eastcentral study areas. No does will be fitted with vaginal implant transmitters during winter 2012–2013 trapping and therefore crews will not rely on these to search for fawns as during previous years. Fawn capture and sampling methods will be the same as previous years. Volunteers will be needed for fawn capture efforts and should contact project investigators if interested in assisting.

Deer monitoring

Deer captured and radiocollared during 2012 will continue to be monitored for survival and movement status throughout 2013 using ground-based and aerial telemetry techniques. All radiocollared deer will be monitored weekly until death or loss of contact with radiocollars occurs. Radio collaring and ear-tagging/mark recapture efforts will continue through winters 2013 and 2014. We will attempt to maintain 70 radiocollared male deer (35 yearlings, 35 adult bucks) using winter trapping to replace individuals lost to mortality or collar loss.

Public outreach

We will be updating our deer research website with preliminary results, photos, videos, and researcher biographies. We heavily rely on volunteers to assist in making our studies successful, and we will continue to invite the public to come out and participate with research. Participation typically consists of riding along with our field crews and observing or if interested, carrying and setting up live traps with researchers. Additionally, we will continue to work with the media to keep the public informed of our preliminary results and will continue providing newsletters to interested individuals. If interested in volunteering please contact Jared Duquette (608) 225-2951 or Mike Watt (608) 221-6358.

Technician hiring

Project investigators Michael Watt, Andrew Norton, Jared Duquette, and Karl Martin hired 10 natural resources research technicians and 2 field crew leaders as members of the 2012–13 field crew; all 12 crew members will be hired for 6 months (January–June 2013) as limited term WDNR employees. These individuals will assist with the buck mortality and fawn recruitment studies. Project investigators will be training the new crew members during early January 2013 in Madison, WI.

Projects timeline

The buck mortality study is designed for five years (2010-11 through 2014-15) within the northern and eastcentral study areas in order to better understand potential effects of temporal and spatial (*e.g.*, habitat) variation on buck mortality. Quantifying effects of various time-dependent (*e.g.*, weather) and time-independent (*e.g.*, habitat, deer density, hunter density, road density, parcel size, etc.) factors across multiple deer management units, will provide insight for improving accuracy and precision of deer population estimation in Wisconsin. Field work (*e.g.*, deer trapping) is scheduled to occur through the winter of 2014 and deer will be monitored until death or their radiocollars are dropped or fail.

The fawn recruitment study is designed for three years (2010–11 through 2012–13) within the northern and eastcentral study areas to provide estimates of potential impacts and relative magnitude of habitat, winter severity, and predator effects on fawn survival and subsequent recruitment in deer populations across forested and agricultural landscapes in Wisconsin. Field work will be completed following the 2013 fawn capture season (late May/early June 2013) and fawns will be monitored until at least one year post-birth or until their collars are dropped or fail.

Detailed annual reports, final project reports, published manuscripts, and biweekly updates throughout the capture seasons will be produced during these studies. Results of this work will be provided to numerous stakeholders, including (but not limited to) external partners and collaborators, media, Wisconsin citizens, DNR staff, policy makers, and as presentations during scientific meetings and outreach efforts across Wisconsin over the duration of these projects.

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AFL-CIO

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USDA-APHIS

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Dan Hansen – Wisconsin Outdoor News

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Frank Boll – In Wisconsin / Wisconsin Public Television

Project Technicians and Crew Leaders

Erin Adams

Katie Allen (asst. crew leader)

Emily Anderson

Jake Behrens

Nate Bieber

Becky Davis

Corinne Dawson

Ryan DeVore

Chelsey Faller

Alixandra Godar

Logan Hahn

Shaun Hilgart

Daniel Jahn

Aaron Johnson (crew leader)

Talesha Karish

Adam Moore

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Gretchen Oleson

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Steffan Peterson

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Christine Priest (crew leader)

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Kristen Wokaniak

Erin Wood

Chloe Wright

SUPPLEMENTS



Releasing a doe from a box trap



Deer captured in netted cage (Clover) trap



Radiocollared buck harvest



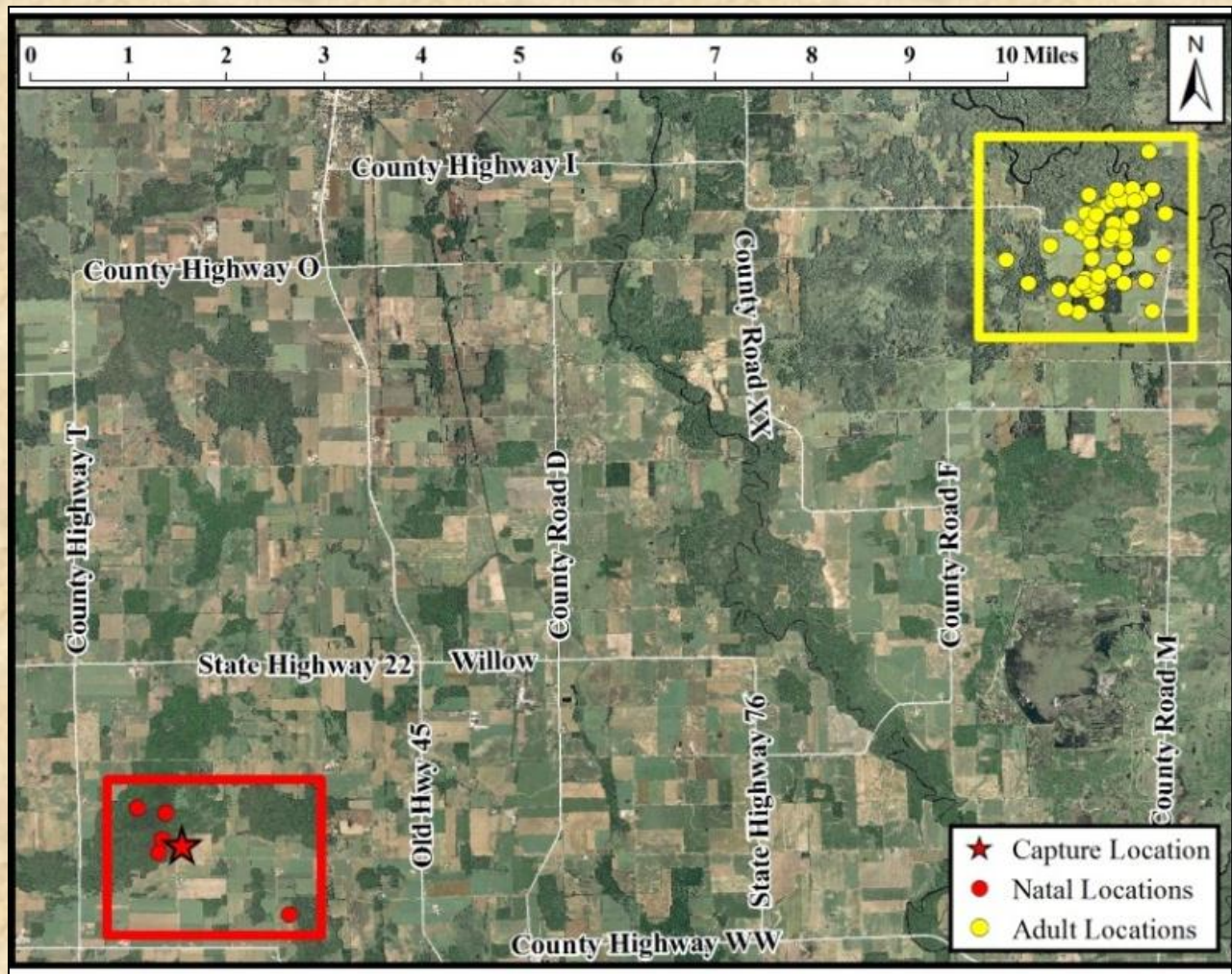
Neonate fawn predated and cached by bobcat, note fawn leg in dashed oval



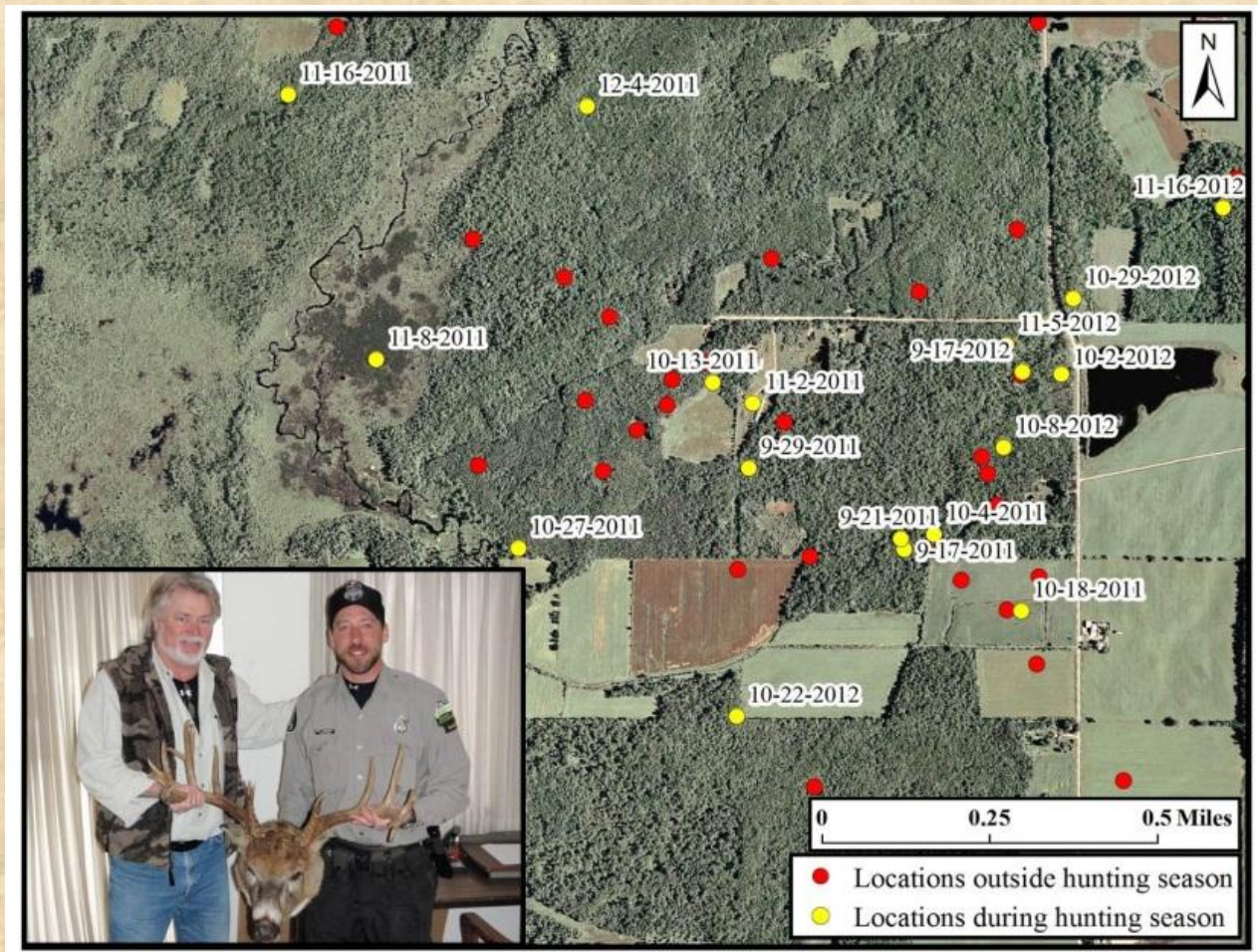
Adult female with metal ear tags (in dashed oval)



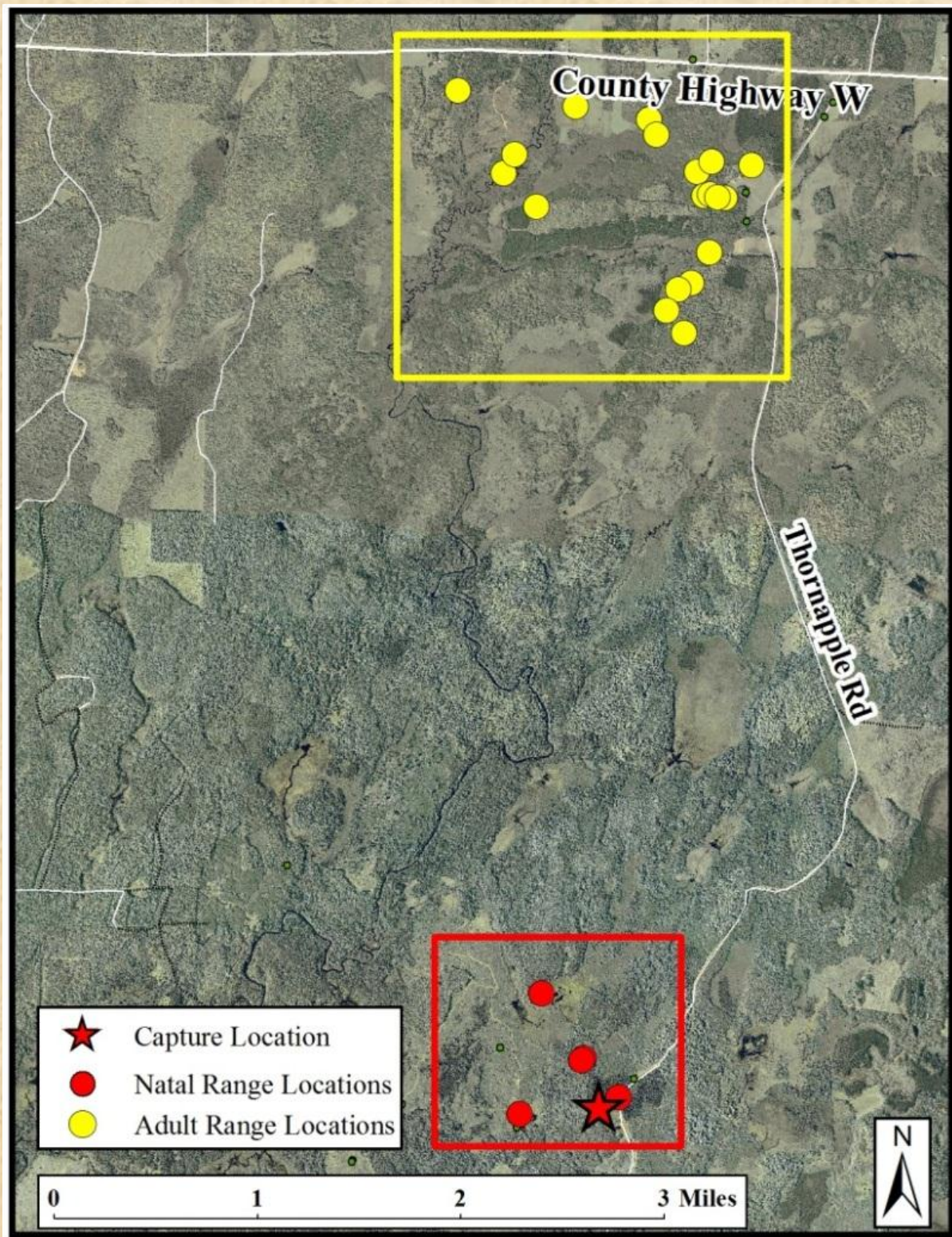
Drop net setup for winter deer capture



Locations during 2011 and 2012 from a 10 month old buck captured on March 11, 2011. He permanently dispersed 11 miles northeast on June 21, 2011. During late-October 2012 and again on November 7, 2012 he was wounded by two different archers when he was 3.5 years old. As of January 15, 2012 he was still alive.



Locations of a 21 month old buck captured on February 19th, 2011 during 2011 and 2012. He was wounded during the hunting season and recovered by researchers on November 18th, 2012 as a 3.5 year old. All locations during the legal hunting season are labeled with the date.



Eight month old male deer, captured January 20th, 2012 in the Sawyer County Forest, 5 miles south of County Highway W and Thornapple Road, and remained in his natal range (red rectangle) through May. On June 2nd, 2012, he dispersed 4 miles north to his adult range (yellow rectangle), where he stayed until November 12th, 2012 when he was presumably harvested but not reported.

CITIZEN SUBMITTED PHOTOS

(submit your photos of tagged deer at <http://dnr.wi.gov/topic/wildlifehabitat/research/whitetaileddeer.html>)



Thank you to John Hanzlik for submitting a great photo of a radiocollared buck



Thank you to Dean Dekarske for submitting this interesting photo of a breeding radiocollared doe and buck (collar was seen on buck in subsequent pictures)



Wisconsin Deer Research Studies
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